

Quantification of Uncertainties in Integrated Spacecraft System Models, Phase II

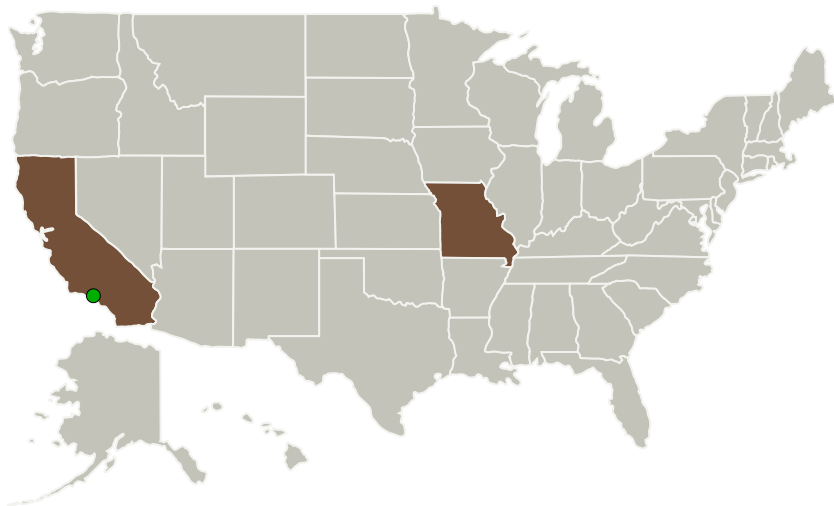
Completed Technology Project (2011 - 2013)



Project Introduction

The objective for the Phase II effort will be to develop a comprehensive, efficient, and flexible uncertainty quantification (UQ) framework implemented within a matured user-friendly software, which will enable the modeling of both inherent and epistemic uncertainties in spacecraft system models, have a general quantification of margins and uncertainties (QMU) capability for system certification and reliability assessment, and utilize advanced methods based on non-intrusive polynomial chaos (NIPC) for efficient and accurate propagation of mixed (inherent+epistemic) uncertainties as also demonstrated under the Phase I effort. In the proposed project, an adaptive uncertainty quantification methodology, which will successively utilize different NIPC methods depending on the size of the problem along with the non-linear global sensitivity information, will be implemented to address the computational expense of UQ in complex spacecraft system simulations with large number of uncertain variables. The developed UQ framework and QMU capability will be demonstrated on a large-scale spacecraft system model that is of interest to NASA. This proposed work will compliment M4 Engineering's expertise in developing simulation technologies that solve relevant demonstration applications. The researchers from MS&T (RI) will guide the implementation of UQ and QMU methodologies and contribute to the proposed effort with their UQ expertise in aerospace simulations.

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
M4 Engineering, Inc.	Lead Organization	Industry Women-Owned Small Business (WOSB)	Long Beach, California
● Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California
Missouri University of Science and Technology	Supporting Organization	Academia	Rolla, Missouri

Primary U.S. Work Locations

California	Missouri
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Project Transitions

▶ **July 2011:** Project Start

✓ **July 2013:** Closed out

Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/139246>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

M4 Engineering, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

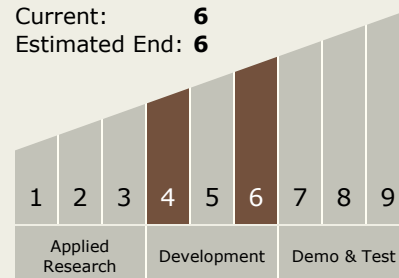
Tyler Winter

Technology Maturity (TRL)

Start: 4

Current: 6

Estimated End: 6



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Technology Areas

Primary:

- TX09 Entry, Descent, and Landing
 - └ TX09.4 Vehicle Systems
 - └ TX09.4.5 Modeling and Simulation for EDL

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System